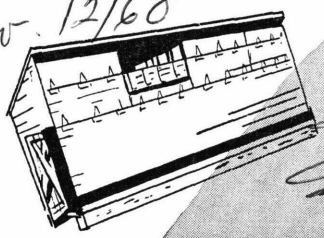
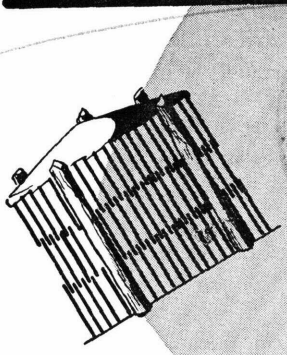
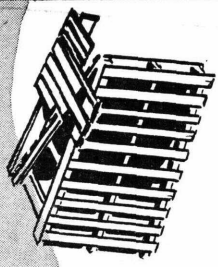
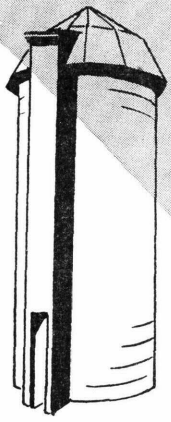
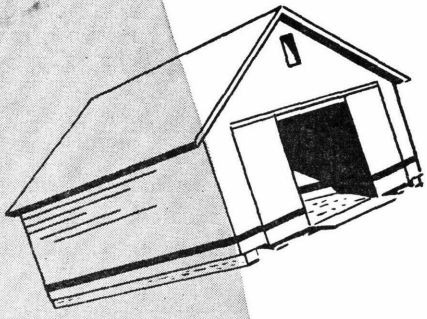


handling and storing *Soft Corn* on the FARM









Farmers' Bulletin No. 1976

U. S. DEPARTMENT OF AGRICULTURE

To Reduce Moisture Content of Soft Corn by Mechanical Drying—

Dry corn promptly after harvesting, using heated or unheated air. Drying equipment now on the market makes this the most positive method of reducing the moisture content of soft corn for safe storage.

Information on mechanical drying is contained in the following publications, which may be obtained from the United States Department of Agriculture:

Leaflet 331, Drying Shelled Corn and Small Grain With Heated Air.
Leaflet 332, Drying Shelled Corn and Small Grain With Unheated Air.
Leaflet 333, Drying Ear Corn With Heated Air.
Leaflet 334, Drying Ear Corn With Unheated Air.

To Reduce Moisture Content of Soft Corn by Natural Ventilation—

1. *Delay harvesting*—the corn will become drier late in the season, and the lower temperatures will retard or prevent winter growth of mold in the crib.

2. *Stay out of the field* when husks and silk are wet from frost, snow, or rain.

3. *Divide the field* and harvest the high ground or the driest part of the crop first.

4. *Equip the picker with a fan* for blowing out loose husks and silk, if this equipment is available.

5. *Sort the corn,* taking out the green or soft ears for immediate feeding.

6. *Equip the elevator with an effective screen* for taking out shelled corn and dirt. If a screen is not furnished by the manufacturer, equip a section of the spouting with rod bottom.

7. *Move the elevator spout frequently,* even if the corn seems to be clean. Elevator screens often take out only about half the shelled corn, and some shelling will occur as the corn drops into the crib.

8. *Provide ample ventilators* to give wind access to the corn in the crib. Place orders early for lumber or ready-built ventilators. Get ventilators built and cribs ready to fill in advance of harvesting date.

Washington, D.C.

Revised May 1954
Slightly revised December 1960

CONTENTS

HANDLING AND STORING SOFT CORN ON THE FARM

By C. K. SHEDD, *formerly agricultural engineer*,[1] and J. R. MCCALMONT, *agricultural engineer, Agricultural Engineering Research Division, Agricultural Research Service*.[2]

SOFT CORN may be a serious problem in the Corn Belt in any year when a late spring delays planting or when wet, cool weather during the growing season prevents proper maturing and drying of the crop. The trouble is likely to be worse after a series of years with longer than normal growing seasons during which farmers become accustomed to growing hybrids of later maturity than can ripen in a normal season. Planting early maturing seed is excellent insurance against soft corn.

Soft corn may range from ears that are substantially mature, but still excessively wet, to corn that is immature and watery. In either case the excess water in kernels and cob is the principal cause of loss in storage.

In the central part of the Corn Belt, corn should be mature (that is, at the point where growth stops) by about September 15 to 20 if the necessary additional drying is to take place in the field before time to harvest. When corn does not reach maturity until October, the cooler weather slows the drying rate and the time left is usually not sufficient for proper drying in the field. Regardless of the cause of the high moisture content, some spoilage is to be expected if ear corn is cribbed in the ordinary way and if the kernels contain more than 20 percent moisture. The higher the moisture content the greater the difficulty of storage.

[1] Retired.

[2] This bulletin is based on investigations by the Agricultural Engineering Research Division in cooperation with various State Agricultural Experiment Stations and the Commodity Stabilization Service.

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Moisture Content for Safe Storage

In a crib, air movement around the ears is greatly restricted, and for safe storage in ordinary cribs the moisture content of the kernels should be down to 20 percent when the corn is cribbed, unless it is to be dried mechanically. In a large part of the Corn Belt, corn cribbed with 20 percent moisture usually does not dry below 15 to 17 percent moisture in winter, but further drying takes place after the weather warms up in spring. Under normal conditions it will be dried down by early summer to 13 percent moisture, which is about the upper limit for safe storage as shelled corn in tight bins.

Testing Moisture Content

The best way to determine the condition of the corn is to test the moisture content of field samples. In many parts of the Corn Belt local grain elevators are equipped for testing the percentage of moisture in shelled corn. Since some ears will be more mature than others, the results of tests may be misleading unless care is taken to get representative samples, at least 2 of which should be taken from the same field. To obtain 1 sample, at least 20 ears should be picked at random in the field, and with a screwdriver 2 rows of kernels should be shelled from each. The shelled corn should be sealed up at once in a pint fruit jar, which should be full or nearly full.

Mechanical Drying in Cribs

Mechanical drying, using either heated or unheated air, is the most positive method of handling soft corn that is to be stored on the farm. Farmer experience and research results have shown that soft corn can be stored satisfactorily if it is dried to 20 percent kernel moisture for storage as ear corn in a well-ventilated crib or to 13 percent moisture for storage as shelled corn.

The most reliable method of drying soft corn is to dry it as ear corn. Soft corn usually contains too much moisture to be shelled satisfactorily before drying. If the moisture content of kernels is above 30 percent, drying with unheated air may result in some mold damage. Drying with heated air can be done successfully regardless of high-moisture content of corn.

Natural Drying in Cribs

Moisture Content of 20 to 25 Percent

Corn containing 20 to 25 percent moisture in the kernels may be severely damaged if harvested and cribbed without special precautions. Harvesting should be delayed until cool weather (the latter part of October or early November in the central part of the Corn Belt). Clean husking is important. Shelled corn should be screened out as the corn goes into the crib. Green or soft ears should be sorted out. Crib ventilators will be beneficial and their use is recommended, especially if the moisture content is near 25 percent or if the crib width exceeds the maximum recommended for the locality. (See fig. 2.)

Moisture Content of 25 to 30 Percent

Corn of 25 to 30 percent moisture that is not mechanically dried is very likely to spoil in the crib. It should be allowed to dry in the field as long as the weather is favorable and should not be harvested until the weather is cold. Then every precaution should be taken to remove husks, silk, and shelled corn, and the corn should be sorted to remove the softest ears. Crib ventilators should be used with spacing not more than half the width of the crib between ventilators or between ventilator and crib wall. If these conditions are provided, with normal drying weather in spring the corn may dry out and store through the following summer without severe damage, but it should be watched closely for any signs of heat or mold damage as the weather warms up in spring. If heating or molding starts at this time, it may be best to feed the corn promptly, to ensile it, or to sell it if possible. If it is necessary to hold it in crib storage—

1. Move and recrib the corn as soon as possible. Loosening what has settled through the winter permits better air circulation in spring, when drying can occur.

2. As the corn is moved, sort out loose husks and silk, shelled corn, and chaff. Any debris that partially fills the spaces between the ears slows air movement. A good deal of the shelled corn and chaff can be sorted out by scooping with a cob scoop rather than with a grain scoop. Elevators can also be so made as to screen out some of these materials. If possible, an air blast should be used to blow out husks and silk.

3. Sort out any soft or moldy ears.

4. Then place the corn in a well-ventilated crib.

Moisture Content Above 30 Percent

Corn containing more than 30 percent moisture in the kernels is likely to spoil in the crib if held longer than through the cold winter months. If possible it would be better to handle it by methods other than cribbing unless it is dried mechanically. There may be heat and mold damage in the crib even in winter, unless good aeration is provided by the methods suggested for corn of lower moisture content. If corn of more than 30 percent moisture must be kept in storage after cold weather ends, the corn should be dried before further storage.

Clean Husking Very Important

Cleanness of husking is of the utmost importance in storing corn of high moisture content, because the presence of husks and silk seriously retards air movement through the crib. Even when corn matures normally, it will be safe to start harvesting several days earlier with a machine that husks clean than with one that leaves much husk and silk with the ears.

Tests show that with the same air pressure and the same thickness of corn, nearly three times as much air passes through clean ear corn as through ear corn with 3.7 percent shelled corn and 1.7 percent debris uniformly distributed throughout

the mass. Such quantities of shelled corn and husks are not unusual when a mechanical picker is used. Shelled corn, chaff, dirt, or other materials that tend to fill the space between ears in storage retard aeration and should be removed before the corn is cribbed.

Portable elevators are now generally equipped with screens to take out shelled corn, chaff, and dirt. Vertical elevators without such screens are used in many double-crib buildings. If a shelled-corn remover is not supplied by the manufacturer of the elevator, a simple home-made separator can be made by building a section of the spouting with rod bottom (fig. 1). The ears pass over the rods, but the shelled corn drops through. The debris removed by

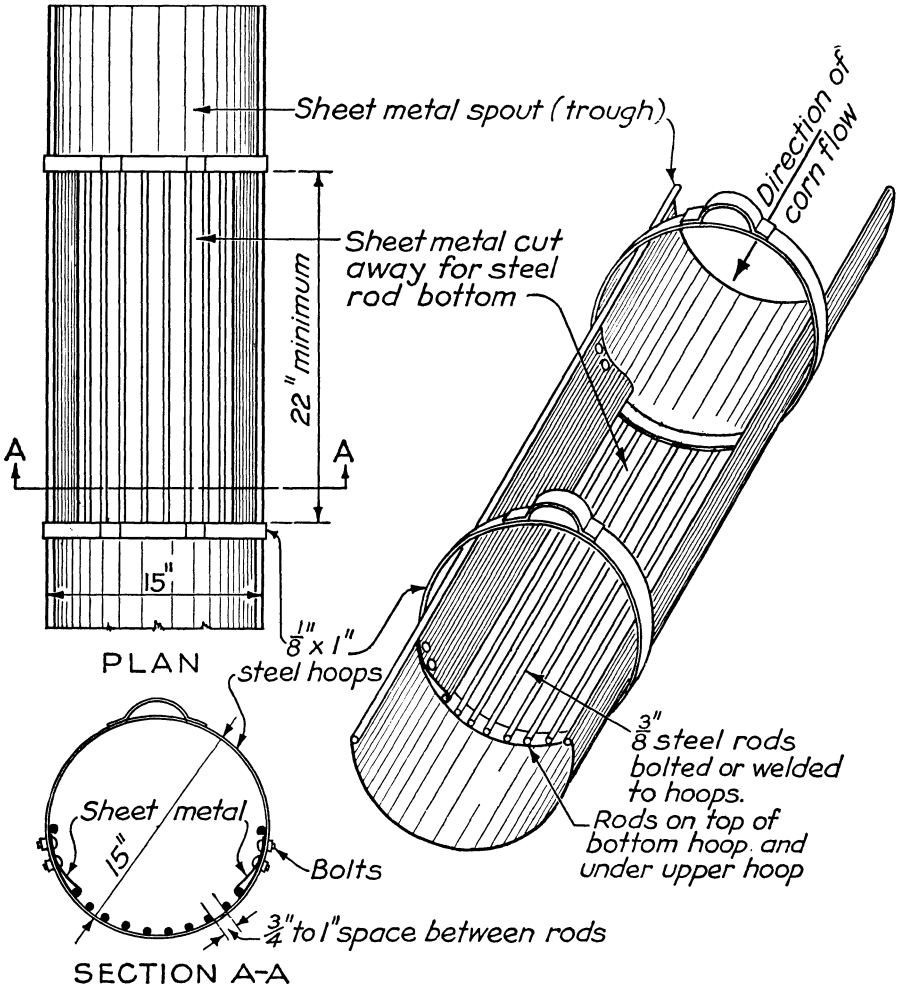

FIGURE 1.—Section of spouting of grain chute equipped with rod-bottom separator, by use of which the ear corn passes into the crib and the shelled corn, chaff, and dirt is removed.

such a screen is likely to be too damp to be stored in quantity. Usually it can be fed to livestock immediately or else spread out in layers thin enough to prevent heating.

Screens for taking out shelled corn and other fine material generally do not remove all of these materials. Also there is some shelling from the ears as they drop into the crib. Some farmers drop the corn from the elevator spout onto a deflector which spreads the corn. Unless a device of this kind is used, the elevator spout should be moved frequently to spread the shelled corn and other fine material.

Normal Crib Requirements

1. The crib should be no wider than the maximum that is recommended for the area where the corn is stored (fig. 2).

2. A floor and good drainage are necessary to protect the corn from ground moisture.

3. A tight roof is essential in humid areas and also in the western part of the Corn Belt, if the corn is to be stored through the summer.

4. The crib should be adequately exposed to the wind. It is wind pressure that causes air movement through the crib.

Width and Exposure of Cribs

The width of the crib is the most important dimension affecting air circulation. A wide crib filled with corn offers more resistance to air movement than a narrow one. Tests show that in a 10-foot crib the air movement per bushel of corn is only about two-thirds that through an 8-foot crib. Filling the driveway of a double crib makes the building into a single crib the entire overall

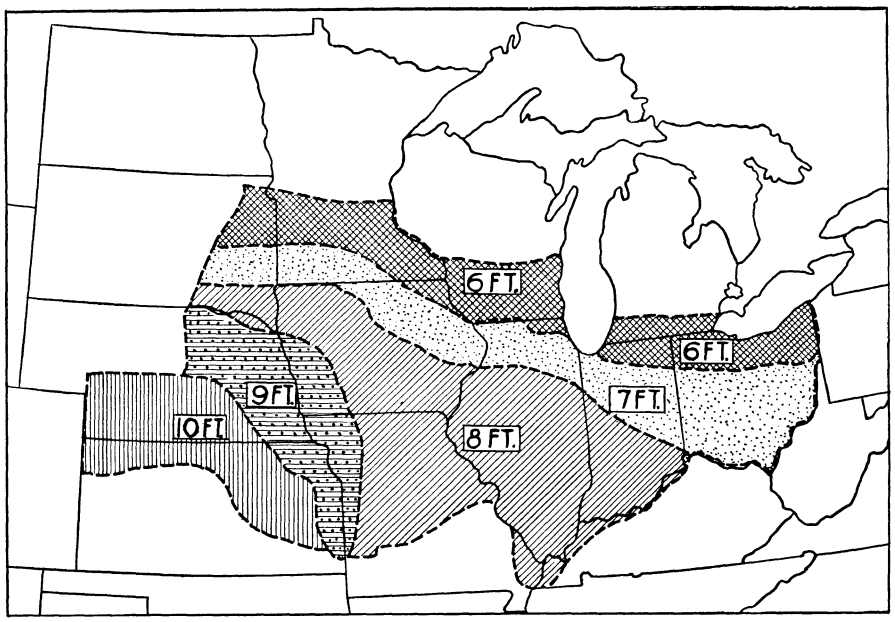

FIGURE 2.—Maximum crib widths recommended for the commercial corn area.

width of the building. This should be done only when the corn contains less than 20 percent moisture and then only through the cold winter months, unless the moisture content is down to 12 or 14 percent.

In frame crib walls covered with 6-inch beveled cribbing, the openings are usually from 15 to 20 percent of the wall area. Other kinds of walls may have more or less opening. Probably a 10-percent opening is about the least that will give good air movement through the crib.

The best aeration will be obtained in a single crib that is fully exposed to the wind. To minimize wind sheltering, the crib should be located at a distance of at least 50 feet from a windbreak or another building. If the crib is located within the farmstead, it will not be fully exposed.

Crib Ventilators

In soft-corn-crop emergencies various types of removable ventilators have been used to increase the air movement through the corn in cribs. Four types of ventilators (*A*, *B*, *C*, and *D*) are shown in figures 3 and 4.

Ventilator *A* (fig. 3), the A-frame ventilator, should run through the center of the crib from end to end to allow the passage of wind. It may be best to block the ventilator midway in its length, but these ventilators have proved successful both with and without blocking. Filling above the top of the ventilator should be delayed until the latter part of the harvest season, when the corn will be drier and the temperatures lower. This ventilator sets below and clear of the crossties in the crib and can be built in sections that are short and not difficult to handle. It causes some inconvenience in emptying the crib.

Ventilator *B* (fig. 3), with vertical sides, runs from end to end of the crib, full height of the corn, so that wind can blow through the center. It is the most effective, but the objections are that (1) considerable lumber is required to build it; (2) the crossties interfere with installation; (3) if built in sections between the crossties the sections are heavy and awkward to handle; and (4) in emptying the crib a central shelling trench cannot be used—both sides of the crib must be opened.

Ventilator *C* (fig. 3), with vertical slats, is lighter in weight and cheaper than either the *A* or *B* type. It is built in sections the height of the picket cribbing (snow fencing)—4 feet. These sections can be set one above another to the height of the corn. It is best adapted to placing crosswise in the crib from wall to wall and can be braced between the studs and spaced as close as required according to the condition of the corn. Cross bracing of the crib does not interfere with an installation of this type, and the ventilators do not cause much inconvenience in emptying the crib.

Ventilator *D* (fig. 4) is a combined ventilator and cross brace and is a permanent installation. It should be located 6 feet 6 inches above the floor to allow headroom for men working on the floor when emptying the crib. The ventilator height of 4½ feet, as shown, is sufficient for a crib 12 feet high. For a crib 16 feet high, another 4½-foot

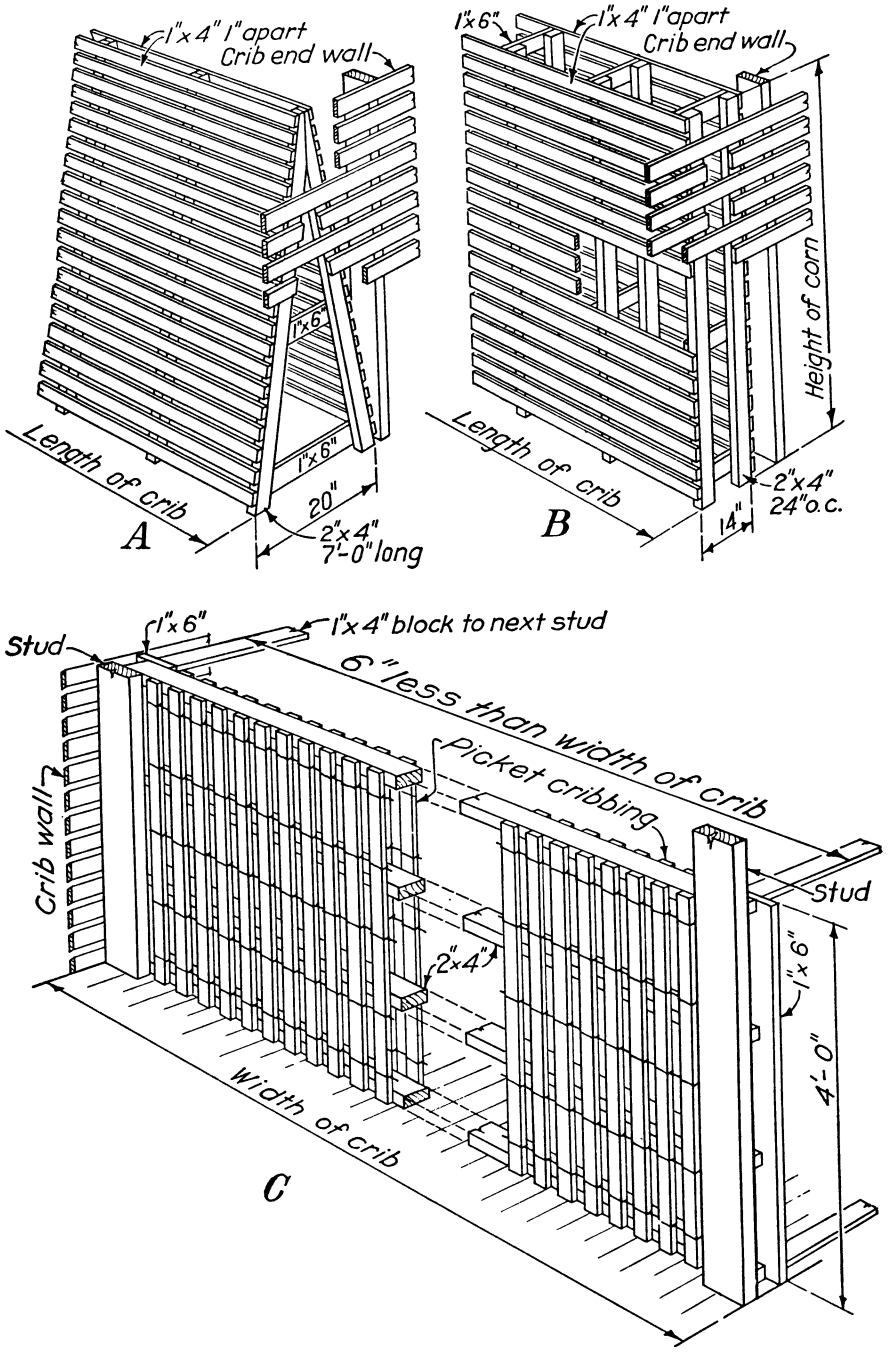

FIGURE 3.—Types of corncrib ventilators: *A*, A-frame, lengthwise; *B*, vertical sides, lengthwise; *C*, double vertical slats, crosswise.

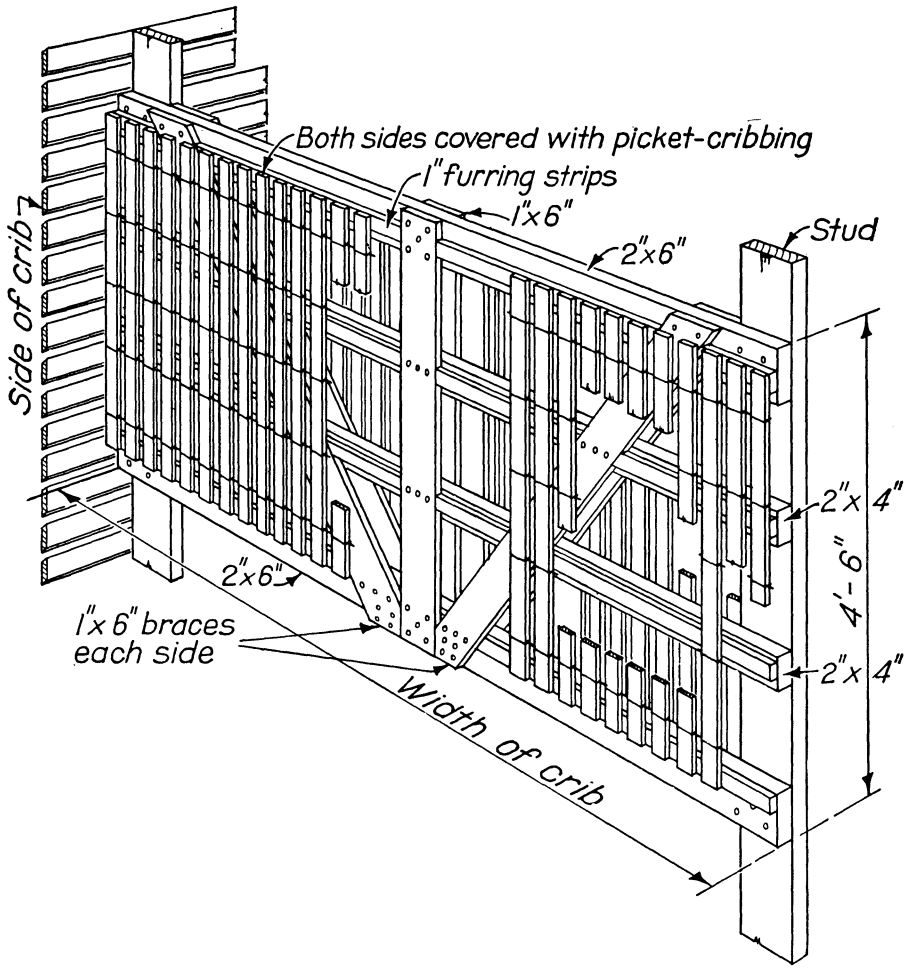

FIGURE 4.—Combination ventilator and cross brace, type *D*, crosswise.

ventilator can be added above. These ventilators should be spaced 4 feet apart, the same as the usual spacing of cross braces, and firmly attached to the studs. Two ½-inch bolts or 5 twentypenny spikes are needed at each end of the lower 2 by 6 timbers. The cost of this combined ventilator and cross-brace type will be more than that of the usual cross brace, but not so much as a cross brace plus a removable ventilator. Removable ventilators should be placed below these permanent ventilators if corn of more than 25 percent moisture is to be stored.

MATERIALS NEEDED FOR VENTILATORS

Type A.—Section 6 feet long, 6½ feet high:

Lumber: Four pieces 2 by 4 inches by 14 feet; thirty-four 1 by 4 inches by 6 feet; one 1 by 6 inches by 10 feet.

Nails: 1¾ pounds sixpenny, ½ pound eightpenny, ¾ pound twelvepenny.

Type B.—Section 8 feet long, 12 feet high:

Lumber: Ten pieces 2 by 4 inches by 12 feet; three 1 by 6 inches by 10 feet; fifty-eight 1 by 4 inches by 8 feet.

Nails: 3½ pounds sixpenny, 1¼ pounds eightpenny.

Type C.—Section 8 feet long, 4 feet high:

Lumber: Four pieces 2 by 4 inches by 8 feet; one 1 by 6 inches by 8 feet; one 1 by 4 inches by 8 feet; 14 linear feet picket cribbing (snow fencing), 4 feet high.

Nails: ¾ pound fourpenny, ¼ pound sixpenny.

Type D.—Section 8 feet long, 4½ feet high:

Lumber:

Ventilator: Two pieces 2 by 4 inches by 8 feet; eight 1 by 2 inches by 8 feet; 15 linear feet picket cribbing (snow fencing), 4 feet high.

Brace: Two pieces 2 by 6 inches by 8 feet; two 1 by 6 inches by 16 feet.

Nails:

Ventilator: ¾ pound fourpenny, ½ pound sixpenny.

Brace: ½ pound eightpenny, ¾ pound twentypenny. Not less than 5 twentypenny nails at each joint of 2- by 6-inch braces, clinched across grain.

Ready-made ventilating tubes have proved to be effective when installed in a horizontal position so that wind will force air movement through the tube. They may be placed either crosswise of the crib or lengthwise in the center of the crib. For storing high-moisture corn there should be no more than 4 feet of corn (or half the crib width) between any of the ventilators described or between the ventilator and the crib wall.

Observations of corn storage have shown that vertical flue-type ventilators are not very effective in corncribs. It is wind pressure that forces air movement through corncribs. The air path through the ventilators should be horizontal and the ends of the ventilator should be exposed to outside air.

Temporary Cribs

When permanent cribs do not have sufficient capacity for the entire crop, temporary cribs should be built for the rest of it. The most common type is that made with woven or welded wire cribbing or with picket cribbing (snow fencing) set in a circle, but in an emergency woven fence wire can be used. The usual diameter of a circular crib is about 16 feet; it is most frequently made with a 50-foot length of fencing. If the corn has a high moisture content the crib diameter should be reduced to 12 feet or even less, especially in the more humid parts of the Corn Belt. A circular crib is not the best type for moist corn, because the diameter is usually greater than the recommended width of a rectangular crib and, when it is filled by elevator, the debris of shelled corn, husks, and silk accumulates in the center, which is the worst possible position for it.

A better type of temporary crib for soft corn is made in rectangular shape by using poles set about 4 feet apart to support wire or picket cribbing for the walls, which are 4 to 10 feet apart, as shown in figure 5. The corn will be better aerated than in a circular crib of ordinary diameter, and the roof is more easily built.

Usually the most practical floor for a temporary crib is made of boards laid on timbers or split logs

that will support them at least 8 inches above the ground. A shelling trench through the center of a circular crib will save labor when the corn is shelled out; it also provides some of the ventilation needed for moist corn.

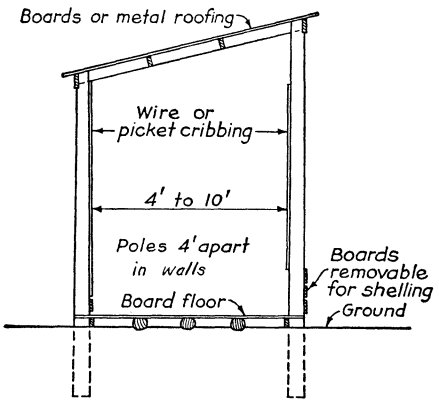

FIGURE 5.—Cross section of temporary crib.

Handling Soft Corn by Methods Other Than Cribbing

Feeding

Immature corn has about the same feeding value per pound of dry matter as mature corn, and as long as it remains sound it can be fed safely to all kinds of stock. This feeding should be begun carefully, however, the quantity being increased gradually to full feed. Caution needs to be exercised in feeding soft corn to poultry. Moldy corn should not be fed to horses and sheep, especially lambs; they are susceptible to injury from such feed. It can safely be fed to cattle, as seemingly they are not so subject to this danger, and also to hogs as long as they will eat it. Prompt feeding unquestionably is the best disposition to make of immature corn, so far as this is practicable. As in feeding sound corn or other grains, protein and mineral supplements should be provided.

Hogging down soft corn is a safe and satisfactory practice, but the hogs must be accustomed to it very gradually. Only a little should be fed at first and the quantity increased gradually to full feed, when the hogs may be turned into the field. Since there is a tendency for greater wastage of feed in hogging down soft corn, it is a good practice to make the hogs clean up successive strips of the cornfield by the use of temporary fences.

Ensiling

Ensiling is one of the best means of saving soft corn. If there is not enough capacity in permanent silos, temporary silos may be used. Trench, snow-fence, and stack silos are described in Miscellaneous Publication 810, Farm Silos, and in numerous publications of the State agricultural colleges.

The whole corn plant can be safely made into silage while immature or very immature. Although such silage is not so valuable as that from more mature corn, because of its high water content and lower feeding value, it makes a satisfactory feed for cattle, and this is one of the best uses for it. Good silage can also be made from corn that has been frozen; after it has been frozen, however, it should be put into the silo as promptly as possible.

Gas-Tight or Sealed Storage

Immature corn or corn picked early with a picker-sheller, having moisture content from 22 percent to the upper limit for shelling, stored in a gas-tight storage makes good feed for cattle and hogs. Tests at the Purdue University Agricultural Experiment Station have shown that a storage tank or silo made of glass-coated steel sheets and equipped with gas-tight hatches can be used successfully for this purpose. Corn with less than 22 percent moisture and more than safe moisture content for dry storage is apt to mold and deteriorate even in gas-tight storages. Ordinary silos have been used successfully in Iowa, Indiana, Michigan, and Wisconsin with corn at 25 percent or more moisture.

Methods varied. In some instances, the silo was lined with plastic sheets and the top surface sealed with plastic and weighted to hold it tight. Silos with walls in good condition have also been used successfully by sealing the door openings and the top with plastic sheets.

The following precautions must be observed to store high-moisture corn successfully:

1. Be sure that the moisture content of the grain lies between recommended limits.
2. Check the storage tank or silo for air leaks.
3. If silo walls show much deterioration or wear, line them with plastic sheets.
4. Seal the top surface to effectively keep air from contacting the grain.

Shocking

Shocking may save a part of a poorly matured crop. Under ordinary conditions in the Corn Belt nearly mature corn can stay in small shocks safely until the ears are dry enough to crib, even if this takes all winter; in fact, the ears will be safer in small well-made shocks than in the crib. If the corn is very immature there is danger of molding in large shocks, but if properly cured, such fodder has about the same feeding value as timothy hay.

Chemical Preservatives

Experiments in the use of salt to preserve soft corn were carried on in 1917 at the Iowa Agricultural Experiment Station. Information also was obtained from a number of farmers who had salted soft corn in cribs. It was found that ½ to 1 pound of salt per 100 pounds of corn (35 to 70 pounds of salt for each 100 bushels) was beneficial in reducing fermentation and mold growth. Under severe conditions, however, the use of salt did not prevent spoilage. It was thought also that any larger proportion of salt would cause difficulties in feeding the corn.

The author knows of no published results of the United States Department of Agriculture or of State agricultural experiment station tests to indicate that any known chemical preparation is satisfactory as a preservative for high-moisture corn.

Drying the corn, either by adequate crib aeration or by mechanical means, is known to be effective, and, at the present stage of knowledge, this is the method to depend upon.

Points to Remember

- Soft corn is a valuable feed—don't let it spoil.
- Mechanical drying to safe moisture content for storage, using heated or unheated air, is the most positive method of saving soft corn.
- Fall and winter feeding and ensiling are good ways to save soft corn.
- Gas-tight or sealed storage will maintain the feed value of high-moisture shelled corn.
- If the corn is to be dried by natural ventilation during crib storage:

  Don't be in a hurry about harvesting; wait until cold weather.

  Husk clean.

  Before harvesting the corn, test its moisture content.

  Provide the extra crib ventilation needed according to moisture content of the corn.

U.S. GOVERNMENT PRINTING OFFICE: 1960

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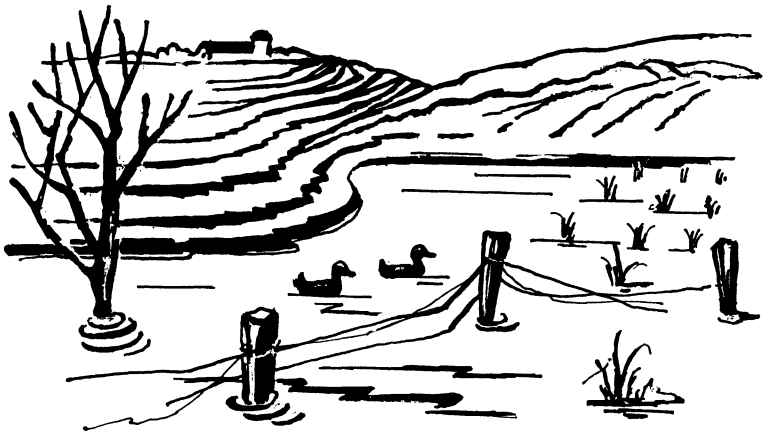

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